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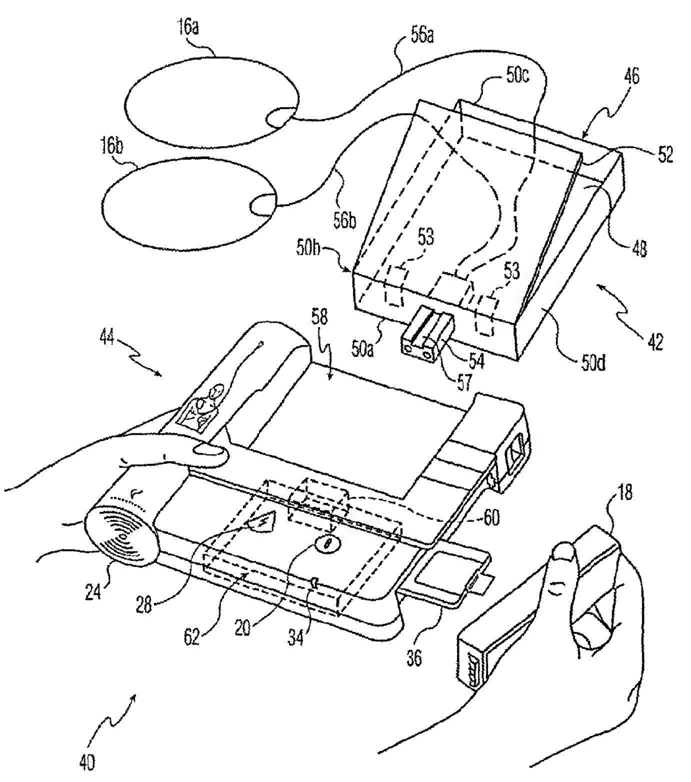

(57) Abstract: A modular automated external defibrillator (AED) system (40) includes a base unit (44) and at least one interconnected module (70). The base unit (44) typically includes a functional circuit (212) and includes an interface (214) that couples the functional circuit (212) to the module (70). Likewise, the module (70) includes an interface (224) that couples the module (70) to the base unit (44). By manufacturing such modular AED models (40) instead of one-piece, i.e., integrated, AED models, a manufacturer can reduce the cost and complexity of its manufacturing process. Furthermore, the manufacturer may be able to bring such a modular AED (40) to market more quickly than it could bring an integrated model of the AED to market. Moreover, a modular AED (40) allows the manufacturer and customer flexibility in respectively providing and selecting feature sets. In addition, a customer can obtain replacements for broken modules (70), and the manufacturer can provide cheaper upgrades by upgrading a module (70) or base unit (44) instead of upgrading the entire AED (40).

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MODULAR MEDICAL DEVICE AND AUTOMATED EXTERNAL DEFIBRILLATOR

The invention relates generally to medical devices, and more particularly to a modular automated external defibrillator (AED), the base unit and modules of the AED, and methods for assembling and using the AED. The modular AED may be manufactured less expensively than a comparable non-modular, *i.e.*, integrated, AED. Furthermore, being a modular AED may facilitate the FDA (Food and Drug Administration) approval/clearance process of the base unit and subsequent combinations of the base unit and modules.

AEDs, which have saved many lives in non-hospital settings, are becoming easier to use; consequently, the demand for AEDs is rising. Typically, an AED analyzes a patient's heart rhythm and, if appropriate, instructs an operator to administer an electrical shock to the patient. For example, a shock can often revive a patient who is experiencing ventricular fibrillation (VF). Because many models of AEDs include only basic diagnostic and safety features, they are often difficult to operate. Therefore, only specially trained persons such as emergency medical technicians (EMTs) can use these older models to administer shocks to patients. Newer models, however, often include advanced diagnostic and safety features that allow minimally trained persons to administer shocks to patients. Consequently, more businesses and individuals are acquiring AEDs to save lives.

A variety of AED models are currently available. For example, some models allow an operator to make few if any decisions regarding treatment of a patient, and thus are suitable for untrained or minimally trained operators. Conversely, other models allow an operator great flexibility in directing the patient's treatment, and thus are suitable for trained operators such as EMTs. Furthermore, some models provide audible or readable instructions in respective languages, typically one language per model. In addition, some models are lower-priced because they include a basic set of features, and other models are higher priced because they include a more comprehensive set of features.

Referring to Fig. 1, most AED models are manufactured, tested, FDA approved, and sold as one-piece, *i.e.,* integrated, units.

Fig. 1 illustrates a conventional AED system *10*, which includes an integrated AED *12* having a one-piece, *i.e.,* integral, housing *14*, and which includes defibrillator electrode pads *16a* and *16b*. The AED *12* includes a battery *18* for supplying power, an

on/off key switch *20*, a display *22* for displaying readable operator instructions, cardiac waveforms, or other information, a speaker *24* for providing audible operator instructions, an AED status indicator *26*, a contrast control *27* for the display *22*, and a shock button *28*, which the operator (hands shown in Fig. 1) presses to deliver a shock to a patient (not shown). The AED *12* also includes a connector *30*, which receives a pad connector *32* to allow coupling of the pads *16a* and *16b* to the AED. Furthermore, the AED *12* may include a microphone *34* for recording the operator's voice and other audible sounds that occur during the rescue, and a storage device such as a data card *36* for storing these sounds along with the patient's ECG and a record of AED events for later study. And in addition to being able to defibrillate the patient, the AED *12* may be able to pace, cardiovert, or provide other electrotherapy to the patient, or may have a manual override that allows the operator more control over otherwise automated functions.

Because it is an integrated unit, introducing a modified version of the AED *12* to respond to specific customer requirements typically requires a manufacturer to design and produce a separate model of the AED. Removing the contrast control *27*, changing the language of the audible or displayed operator instructions, removing the status indicator *26*, and changing the shape of the housing *12* are examples of modifications that typically require the manufacturer to produce a separate AED model. Moreover, different customers may want the AED *12* to be capable of different electrotherapies or combinations of electrotherapies. For example, one customer may want the AED *12* to be capable of defibrillation only, and another customer may want the AED to be capable of pacing, cardioversion, and defibrillation. Consequently, the manufacturer would typically have to produce a separate AED model for each supported electrotherapy or combination of electrotherapies.

Unfortunately, the more models of integrated AEDs a manufacturer produces, the more complex and expensive its overall manufacturing and logistical operations. An AED model may be manufactured independently of other AED models. That is, a model may have its own dedicated assembly/test line, and thus may have its own dedicated manufacturing/testing equipment, assemblers, testers, and troubleshooters. If the model is discontinued, then the equipment may be useless to the manufacturer, or may need revamping for use with other models. Also, the manufacturer may need to retrain the assemblers, testers, and troubleshooters for another model. Furthermore, because materials and components are typically more expensive if purchased in smaller lots, producing different AED models having different materials or components may increase the manufacturer's costs for materials and components. Moreover, the manufacture often must

receive FDA approval of each model. The FDA-approval process takes time and may lengthen a model's time to market. These problems may also plague manufacturers of integrated medical devices other than AEDs.

Consequently, there is a need for a medical device, such as an AED, that avoids some or all of the shortcomings of a conventionally integrated medical device.

A modular AED includes an interconnected base unit and one or more modules.

The base unit includes a functional base-unit circuit and a base-unit interface that electronically couples the circuit to a module. And the module includes a module interface that electronically couples the module to the base unit.

Such a modular AED is often easier and less expensive to manufacture than an integrated AED. For example, if multiple models of a modular AED incorporate the same base unit and some of the same modules, then the manufacturer can often purchase common components in larger lots and reduce the number of assembly/testing lines as compared to several integrated devices. Furthermore, the manufacturer may reduce the overall time required for FDA approval by seeking separate approval for different base units and modules. For example, if the manufacturer introduces a new model having an approved base unit but one or more new, unapproved modules, then the manufacturer may need FDA approval of the new modules only. The approval process for the new modules may be easier, faster, and cheaper than an approval process for a comparable integrated model or for the whole new model, *i.e.,* the intercoupled base unit and new modules.

Fig. 1 is a view of a conventional AED system that includes an integrated AED.

Fig. 2 is an exploded view of a modular AED according to an embodiment of the invention.

Fig. 3 is a view of a control module that can replace the pad-cartridge module of Fig. 2 according to an embodiment of the invention.

Fig. 4 is a view of a monitor module that can replace the pad-cartridge module of Fig. 2 according to an embodiment of the invention.

Fig. 5 is a view of a training-pad-cartridge module that can replace the pad-cartridge module of Fig. 2 according to an embodiment of the invention.

Fig. 6 is a view of a communication module that can replace the pad-cartridge module of Fig. 2 according to an embodiment of the invention.

Fig. 7 is an exploded view of another modular AED according to an embodiment of the invention.

Fig. 8 is a view of an enhanced control module that can replace the control module or the pad-cartridge module of Fig. 7 according to an embodiment of the invention.

Fig. 9 is a view of a full-featured control module that can replace one or both of the control module and pad-cartridge module of Fig. 7 according to an embodiment of the invention.

Fig. 10 is a view of a monitor module that can replace one or both of the control module and pad-cartridge module of Fig. 7 according to an embodiment of the invention.

Fig. 11 is an exploded view of yet another modular AED according to an embodiment of the invention.

Fig. 12 is a circuit-block diagram of the AED base units of Figs. 2 , 7, and 11 according to an embodiment of the invention.

Fig. 13 is a circuit-block diagram of the AED modules of Figs. 2 - 6 and 8 - 11 according to an embodiment of the invention.

Fig. 14 is a circuit-block diagram of the modular AEDs of Figs. 2, 7, and 11 according to an embodiment of the invention.

The following discussion is presented to enable a person skilled in the art to make and use the invention. Various modifications to the preferred embodiments will be readily apparent to those skilled in the art, and the generic principles herein may be applied to other embodiments and applications without departing from the spirit and scope of the present invention as defined by the appended claims. Thus, the present invention is not intended to be limited to the embodiments shown, but is to be accorded the widest scope consistent with the principles and features disclosed herein. Furthermore, "automated external defibrillator" or "AED" is any defibrillator that determines whether a patient has a shockable heart rhythm.

Fig. 2 is an exploded view of a modular AED system *40*, which includes a pad-cartridge module, *i.e.,* cartridge assembly, *42* and an AED base unit *44* according to an embodiment of the invention. For clarity, like numerals refer to elements common to the

system *10* of Fig. 1. The modular AED system *40* is often easier and less expensive to manufacture than the integrated AED system *10* of Fig. 1. For example, multiple models of the modular AED system *40* may incorporate the same base unit *44*. Therefore, the manufacturer can often purchase components for the base unit *44* in relatively large lots, and have a single assembly/testing line for the base unit. Furthermore, once the FDA has approved the base unit *44*, the manufacturer typically need only obtain FDA approval for new modules to be incorporated into the AED system *40*. Similarly, once the FDA has approved a module, the manufacturer typically need only obtain FDA approval for new base units to be incorporated into the AED system *40*.

The cartridge assembly *42* includes the electrode pads *16a* and *16b* and a cartridge *46*. The cartridge *46* has a bottom, *i.e.*, tray, *48*, side walls *50a - 50d*, and lid *52*, which may be hinged to a side wall such as the side wall *50a* with one or more hinges *53*. The cartridge *46* also includes an electrode-pad connector *54*, which may extend through a side wall such as the side wall *50a*, helps to secure the cartridge *46* to the AED base unit *44*, and electrically connects the electrode pads *16a* and *16b* to the base unit via electrode-pad wire leads *56a* and *56b*. Alternatively, the connector *54* may extend through the tray *48*. The leads *56a* and *56b* are conventionally attached to the connector *54*. The connector *54* may include an information provider such as a groove *57*, which provides information, such as the type (*e.g.*, pediatric, adult, or training) of pads *16a* and *16b*, to the base unit *44*. The cartridge *46* may also include a conventional latch mechanism (not shown) for latching the lid *52* to one or more of the side walls *50a - 50d*. This and other embodiments of the cartridge assembly *42* are further discussed in U.S. Patent Application Ser. No. 09/746,123, entitled CARTRIDGE FOR STORING AN ELECTRODE PAD AND METHODS FOR USING AND MAKING THE CARTRIDGE, filed on December 22, 2000, which is incorporated by reference.

Still referring to Fig. 2, in addition to the battery *18*, on/off switch *20*, speaker *24*, shock button *28*, microphone *34*, and data card *36*, the AED base unit *44* includes a receptacle *58* and a connector *60* for respectively receiving the cartridge *46* and the connector *54*. The base unit *44* may read the information provided by the groove *57* using conventional techniques or a technique such as that disclosed in U.S. Patent Application Ser. No. 09/746,123, entitled CARTRIDGE FOR STORING AN ELECTRODE PAD AND METHODS FOR USING AND MAKING THE CARTRIDGE, filed on December 22, 2000, which is heretofore incorporated by reference. The connectors *54* and *60*, which electrically interconnect the cartridge assembly *42* and the base unit *44*, may be the sole means by which

the cartridge assembly and the base unit are attached to one another. Alternatively, means such as Velcro® strips (not shown), mating grooves (not shown) in the side walls of the receptacle *58* and the side walls *50b* and *50d* of the cartridge *46*, or other conventional means may be included to attach the cartridge *46* to the base unit *44*. Furthermore, the manufacturer may permanently attach the cartridge *46* to the base unit *44* to prevent one from taking the modular AED system *40* apart. One would, however, be able to replace the pads *16a* and *16b* without replacing the cartridge *46*. Or, the manufacturer may allow one to remove the cartridge *46* from the base unit *44* such that he/she can replace the cartridge assembly *42* with another cartridge assembly or module (not shown in Fig. 2).

Furthermore, the AED base unit *44* may include a compartment *62* for storing defibrillator electrode pads, such as the pads *16a* and *16b*, when a module other than the cartridge assembly *42* is in the receptacle *58*. The connector *60* or another connector (not shown) may connect the pads in the compartment *62* to the base unit *44*. In addition, the compartment *62* may include a lid or other cover (not shown).

The operation of the modular AED system *40* is discussed according to an embodiment of the invention. During an emergency where it is determined that a patient (not shown) may need a shock, the operator (hands shown in Fig. 2) retrieves the AED base unit *44* and installs the battery *18* if it is not already installed. Next, the operator inserts the connector *54* into the connector *60*, and thus inserts the cartridge *46* into the receptacle *58*, if the cartridge *46* is not already installed. Then, the operator opens the lid *52* and removes the electrode pads *16a* and *16b* from the cartridge *46*. Next, the operator activates the base unit *44* by turning the on/off switch *20* to the "on" position, and in response to written or spoken instructions, places the electrode pads *16a* and *16b* on the patient (not shown). The base unit *44* then analyzes the patient's ECG to determine whether the patient is suffering from a shockable heart rhythm. If the base unit *44* determines that the patient is suffering from a shockable heart rhythm, it then instructs the operator to press the shock button *28*. Conversely, if the base unit *44* determines that the patient is not suffering from a shockable heart rhythm, it may inform the operator to seek appropriate non-shock treatment for the patient and may disable the shock button *28*. After the operator has treated the patient, he/she typically installs new pads *16a* and *16b* or an entire new cartridge assembly *42*. Thus, with new pads or a new cartridge assembly installed, the modular AED system *40* is ready for its next use. Alternatively, one may wait until the next use of the AED system *40* to install new pads or a new cartridge assembly.

Although the modular AED system *40* is discussed, other modular medical devices or systems are contemplated. Furthermore, although the AED system *40* is discussed having a pair of pads *16a* and *16b*, the system may have more or fewer pads. Or, the system *40* may be capable of, and include pads that are suitable for, electrotherapies other than or in addition to defibrillating. Such electrotherapies may include monitoring, cardioverting, or pacing. Moreover, the system *40* may include a manual override that allows the operator (hands shown in Fig. 2) more control over otherwise automated functions. In one embodiment, the modular system *40* is configured with a certain set of one or more modules (such as the cartridge assembly *42*) in conjunction with the base unit *44*. This configuration is typically determined by the type of AED features the customer/operator desires or the particular model of the AED system *40* that the manufacturer produces. Such a configure-to-order (CTO) scenario allows the customer/operator to choose a modular AED system *40* having the features and functionality he/she needs.

Fig. 3 is a control module *70* that can replace the cartridge assembly *42* of Fig. 2 according to an embodiment of the invention. The manufacturer may give an operator (not shown in Fig. 3) the ability to configure the AED system *40* (Fig. 2) to meet his/her needs. Specifically, the operator can configure the system *40* by inserting the module *70* into the receptacle *58* (Fig. 2) of the AED base unit *44* (Fig. 2) in place of the cartridge assembly *42*. The module *70* typically receives power from the base unit *44*, and provides additional features to the modular AED system *40* (Fig. 2) as described below.

The control module *70* includes a display *72*, status indicator *74*, control knob *76*, pad connector *78*, indicator light-emitting diodes (LEDs) *80*, a connector *82*, and push buttons *84*. The display *72* displays operator information such as patient-treatment instructions or an AED function-select menu. The indicator *74* and LEDs *80* provide the status of the AED *40*. For example, the indicator *74*, LEDs *80*, or both may indicate when the shock circuitry (Fig. 8) is ready to deliver a shock to the patient (not shown). The control knob *76* allows the operator to manipulate the display *72*. For example, the operator may control the brightness or contrast of the display *72* by turning the knob *76*. The connector *78* allows one to connect a set of pads, such as the pads *16a* and *16b* (Fig. 2), to the AED system *40*. The connector *82* is similar to the connector *54* (Fig. 2) and mates with the base-unit connector *60* (Fig. 2). Although not shown, the connector *82* may include an information provider such as the groove *57* (Fig. 2). The push buttons *84* allow the operator to select software-menu items from the display *72*, or may provide other features. Alternatively, the

display *72* may include a touch-sensitive screen so that the manufacturer can omit the buttons *84*.

Other embodiments of the control module *70* may have a different layout or different controls, or may provide different features. For example, the positions of the display *72*, status indicator *74*, selection knob *76*, pad connector *78*, indicator LEDs *80*, connector *82*, and push buttons *84* may be rearranged. Furthermore, the knob *76* may control defibrillation functions other than the brightness or contrast of the display *72*. For example, the knob *76* may control the level of the shock energy or the volume of the speaker *24* (Fig. 2). Furthermore, these components may be replaced with equivalent components. For example, although the pad and module connectors *78* and *82* are respectively shown as female and male connectors, they may be male and female connectors. Or the knob *76* or buttons *84* may be replaced with other types of control components such as switches. In addition, the display *72* may provide the status of the AED system *40* so that the manufacturer can omit the status indicator *74* or LEDs *80*. Moreover, although the connectors *82* and *60* (Fig. 2) may be the sole means by which the module *70* is attached to the base unit *44* (Fig. 2), means such as, screws, fasteners, or Velcro® strips (not shown), mating grooves (not shown) in the side walls of the receptacle *58* and the side walls *86a* and *86b* of the module *70*, or other conventional means may be included to attach the module *70* to the base unit *44*. Furthermore, the module *70* may provide power to the base unit *44*. In addition, the manufacturer may permanently attach the module *70* to the base unit *44* to prevent one from taking the modular AED system *40* apart. Or, the manufacturer may allow one to remove the module *70* from the base unit *44* such that he/she can replace the module with another module or the cartridge assembly *42* (Fig. 2).

Fig. 4 is a monitor module *90* that can replace the cartridge assembly *42* of Fig. 2 according to an embodiment of the invention, where like numbers identify like components with respect to the control module *70* of Fig. 3. Specifically, an operator (not shown in Fig. 4) can insert the module *90* into the receptacle *58* (Fig. 2) of the base unit *44* in place of the cartridge assembly *42*. The module *90* typically receives power from the base unit *44*, and provides additional features to the modular AED system *40* (Fig. 2) as described below.

Like the control module *70* of Fig. 3, the monitor module *90* includes a display *72*, control knob *76*, pad connector *78*, indicator light-emitting diodes (LEDs) *80*, connector *82*, and push buttons *84*. The display *72* displays information such as patient-treatment instructions, an AED function-select menu, or a patient waveform such as

the patient's electrocardiogram (ECG). The display *72* may also display the status of the AED system *40* (Fig. 2).

Other embodiments of the monitor module *90* are contemplated. These embodiments may incorporate modifications similar to those discussed above in conjunction with Fig. 3 for the other embodiments of the control module *70*.

Fig. 5 is a training cartridge assembly *100* that can replace the cartridge assembly *42* of Fig. 2 according to an embodiment of the invention, where like numbers identify like components with respect to the cartridge assembly *42*. Specifically, an operator (not shown in Fig. 5) can adjust the training-scenario selector *102* to simulate any of a number of different rescue or training scenarios. If power is needed, the selector *102* typically receives it from the base unit *44*, and provides training features to the modular AED system *40* (Fig. 2) as described below. Alternatively, the cartridge assembly *100* may have its own power supply (not shown) such as a battery.

The cartridge assembly *100* is similar to the cartridge assembly *42* of Fig. 2 except that it includes the training-scenario selector *102*, and, to prevent accidental shock delivery, the connector *54* does not electrically couple the electrode pads *16a* and *16b* to the base unit *44* (Fig. 2). Furthermore, to prevent inadvertent use of the assembly *100* during an actual rescue, an optional flag *104* indicates that the assembly *100* is a training assembly.

In operation, an operator (not shown in Fig. 5) sets a selector knob *106* of the selector *102* to a desired training scenario that allows him/her to train a student (not shown) in the use of the AED system *40* (Fig. 2). For example, the operator can set the knob *106* so that the selector *102* causes the AED base unit *44* to behave as if it has determined that a patient (not shown) is suffering from a shockable heart condition. Then, while the operator studies and comments on his/her performance, the student tries to revive the patient using the AED system *40*. For such training purposes, the patient can be a mannequin. AED training devices and techniques are further discussed in U.S. Patents 5,611,815, 5,662,690, and 5,993,219, which are incorporated by reference.

Fig. 6 is a communication module *110* that can replace the cartridge assembly *42* of Fig. 2 according to an embodiment of the invention, where like numbers identify like components with respect to the monitor module *90* of Fig. 4. Specifically, an operator (not shown in Fig. 6) can insert the module *110* into the receptacle *58* (Fig. 2) of the AED base unit *44* in place of the cartridge assembly *42*. The module *110* typically receives power from the base unit *44*, and provides additional features to the modular AED system *40* (Fig. 2) as described below.

In addition to a base-unit connector *82*, the communication module *110* includes a conventional telephone keypad *112*, female telephone connector *114* for receiving a male connector *116*, and an optional antenna *118*. After completion of the patient-rescue operation, the operator (not shown in Fig. 6) connects the connector *114* to the connector *116* and dials the telephone number of a data-collection center (not shown). Then, the AED base unit *44* (Fig. 2) uses the module *110* as a modem to download rescue data from the card *36* (Fig. 2) or from the base unit in general to the data-collection center via a phone line *120*. Alternatively, the base unit *44* uses the module *110* as a wireless modem to download the rescue data via the antenna *118* and a wireless channel. The base unit *44* may also receive data from the data-collection center via the telephone line *120* or the wireless channel. Other functions of the module *110* include downloading new or updated software for the base unit *44*, module *110*, or both, or downloading rescue instructions for the operator.

Other embodiments of the monitor module *110* are contemplated. These embodiments may incorporate modifications similar to those discussed above in conjunction with Fig. 3 for the other embodiments of the control module *70*.

Fig. 7 is an exploded view of a modular AED system *130*, which includes an electrode-pad module, *i.e.,* cartridge assembly, *132*, a control module *134*, and an AED base unit *136* according to an embodiment of the invention. For clarity, like numerals refer to elements common to the AED system *40* (Fig. 2). A difference between the AED system *130* and the AED system *40* is that the base unit *136* lacks a shock button and an on/off switch. Therefore, in this embodiment, the AED *130* requires a control module such as the control module *134*. In addition, although not shown in Fig. 7, the base unit *136* may include a pad storage compartment such as the storage compartment *62* of the base unit *44* (Fig. 2).

The cartridge assembly *132* includes a connector *138* to which the pads 16a and *16b* are connected via the leads *56a* and *56b*. Unlike the connector *54* (Fig. 2) of the cartridge assembly *42* (Fig. 2), the connector *138* extends through the bottom *48* of the cartridge *46*. But like the connector *54*, the connector *138* may include an information provider such as the groove *57* (Fig. 2). Otherwise, the cartridge assembly *132* is similar to the cartridge assembly *42*.

The control module *134* typically receives power from the AED base unit *136*, and includes an on/off switch *140*, shock button *142*, and side walls *144a* and *144b*. The switch *140* and button *142* may be similar to the on/off switch *20* and the shock button *28* of Fig. 2, respectively. The module *134* also includes a connector (not shown) that extends from the bottom of the module and that may include an information provider such as the groove *57*

(Fig. 2). Other embodiments of the module *134* are contemplated. These embodiments may incorporate modifications similar to those discussed above in conjunction with Fig. 3 for the other embodiments of the control module *70*.

Furthermore, in addition to the battery *18*, speaker *24*, microphone *34*, and data card *36*, the AED base unit *136* includes a receptacle *146* and connectors *148* and *150* for respectively receiving the connector *138* of the cartridge *46* and the connector (not shown) of the control module *134*. The base unit *136* may read the information provided by information providers on the connector *138* and the connector of the module *134*. The connectors *138*, *148*, *150*, and the control-module connector, which electrically interconnect the cartridge assembly *132*, the control module *134*, and the base unit *136*, may be the sole means by which the cartridge assembly and the control module are attached to the base unit. Alternatively, other attachment means, such as those described above in conjunction with Figs. 2 and 3, may be included to attach the cartridge *46* and the module *134* to the base unit *136*. Furthermore, the manufacturer may permanently attach the cartridge assembly *132* and the control module *134* to the base unit *136* to prevent an operator (hands shown in Fig. 7) from taking the modular AED system *130* apart. Or, the manufacturer may allow the operator to remove the cartridge assembly *132* or the control module *134* from the base unit *136* such that he/she can replace the cartridge assembly or control module with another cartridge assembly or module (not shown in Fig. 7). Where the cartridge assembly *132* is permanently attached to the base unit *136*, the operator can replace the pads *16a* and *16b* without replacing the cartridge *46*.

Still referring to Fig. 7, the operation of the modular AED system *130* is discussed according to an embodiment of the invention. During an emergency where it is determined that a patient (not shown) may need a shock, the operator (hands shown in Fig. 7) retrieves the AED base unit *130* and installs the battery *18* if it is not already installed. Next, the operator inserts the connector *138* into the connector *148*, and thus inserts the cartridge *46* into one end of the receptacle *146*, if the cartridge *46* is not already installed. Similarly, the operator inserts the control-module connector (not shown) into the connector *150*, and thus inserts the control module *134* into the other end of the receptacle *146*, if the control module is not already installed. Then, the operator opens the lid *52* and removes the electrode pads *16a* and *16b* from the cartridge *46*. Next, the operator activates the control module *134* and the base unit *136* by turning the on/off switch *140* to the "on" position, and in response to written or spoken (via the speaker *24*) instructions, places the electrode pads *16a* and *16b* on the patient (not shown). The base unit *136* then analyzes the patient's ECG to determine

whether the patient is suffering from a shockable heart rhythm. If the base unit *136* determines that the patient is suffering from a shockable heart rhythm, then it instructs the operator to depress the shock button *142*. Conversely, if the base unit *136* determines that the patient is not suffering from a shockable heart rhythm, it may inform the operator (*e.g.*, via the speaker *24*) to seek appropriate non-shock treatment for the patient and may disable the shock button *142*. After the operator has treated the patient, he/she installs new pads *16a* and *16b*, or an entire new cartridge assembly *132*. Thus, with new pads or a new cartridge assembly installed, the AED system *130* is ready for its next use. Alternatively, the operator may wait until the next use of the system *130* to install a new cartridge assembly or pads. Typically, the operator does not detach the control module *134* from the base unit *136* once the control module is installed.

Fig. 8 is an enhanced control module *160* that can replace the cartridge assembly *132* or the control module *134* of Fig. 7 according to an embodiment of the invention, where like numbers reference like components with respect to the control module *134*. Typically, an operator (not shown in Fig. 8) inserts the module *160* into the base-unit receptacle *146* (Fig. 7) in place of the control module *134*. The control module *160* has more features than the control module *134* as described below.

The control module *160* typically receives power from the AED base unit *136* (Fig. 7), and, in addition to the on/off switch *140* and shock button *142*, includes a display *162*, control knob *164*, and push buttons *166*, which are respectively similar to the display *72*, control knob *76*, and push buttons *84* of Fig. 3. The module *160* also includes a connector (not shown) that extends from its bottom and that mates with the connector *150* (Fig. 7) of the base unit *136*. This connector may include an information provider such as the groove *57* (Fig. 2).

Other embodiments of the control module *160* are contemplated. These embodiments may incorporate modifications similar to those discussed above in conjunction with Fig. 3 for the other embodiments of the control module *70*.

Fig. 9 is a full-featured control module *170* that can replace one or both of the cartridge assembly *132* and the control module *134* of Fig. 7 according to an embodiment of the invention, where like numbers reference like components with respect to the control module *160* (Fig. 8). Typically, the module *170* is sized to occupy the entire base-unit receptacle *146* (Fig. 7). Therefore, the operator (not shown in Fig. 9) inserts the module *170* into the base-unit receptacle *146* in place of the cartridge assembly *132* and the control

module *134*. The control module *170* has more features than the enhanced control module *160* as described below.

The control module *170* typically receives power from the AED base unit *136* (Fig. 7), and, in addition to the on/off switch *140*, shock button *142*, display *162*, control knob *164*, and push buttons *166*, includes a status indicator *172*, indicator LEDs *174*, and a pad connector *176*, which are respectively similar to the status indicator *74*, LEDs *80*, and pad connector *78* of Fig. 3. The module *170* also includes a pair of connectors (not shown) that extend from its bottom and that respectively mate with the connectors *148* and *150* of the base unit *136*. One or both of these connectors may include an information provider such as the groove *57* (Fig. 2). Alternatively, the module *170* may include a single connector (not shown) that extends from the its bottom and that mates with one of the connectors *148* and *150* of the base unit *136*.

Other embodiments of the control module *170* are contemplated. These embodiments may incorporate modifications similar to those discussed above in conjunction with Fig. 3 for the other embodiments of the control module *70*. Furthermore, the module *170* may be sized to occupy only a portion of the base-unit receptacle *146* (Fig. 7) such that the cartridge assembly *132* or another module (not shown) can simultaneously occupy the receptacle *146* with the module *170*.

Fig. 10 is a monitor module *180* that can replace one or both of the cartridge assembly *132* and the control module *134* of Fig. 7 according to an embodiment of the invention, where like numbers identify like components with respect to the control module *170* (Fig. 9). Typically, the module *180* is sized to occupy the entire base-unit receptacle *146* (Fig. 7). Therefore, the operator (not shown in Fig. 10) inserts the module *180* into the receptacle *146* of the base unit *136* in place of the cartridge assembly *132* and the control module *134*. The module *180* typically provides additional features to the modular AED system *130* (Fig. 7) as described below.

The monitor module *180* typically receives power from the AED base unit *136* (Fig. 7), and includes on/off switch *140*, shock button *142*, display *162*, control knob *164*, push buttons *166*, indicator light-emitting diodes (LEDs) *174*, and pad connector *176*. The display *162* displays information such as patient-treatment instructions, an AED function-select menu, or a patient waveform such as the patient's electrocardiogram (ECG). The display *162* may also display the status of the AED *130*. Furthermore, the module *180* may include a single connector (not shown) that extends from the bottom of the module and that mates with one of the base-unit connectors *148* or *150* (Fig. 7). Alternatively, the module

180 may include two such connectors that each mate with a respective one of the base-unit connectors *148* and *150*. One or both of these connectors may include an information provider such as the groove *57* (Fig. 2).

Other embodiments of the monitor module *180* are contemplated. These embodiments may incorporate modifications similar to those discussed above in conjunction with Fig. 3 for the other embodiments of the control module *70*. Furthermore, the module *180* may be sized to occupy only a portion of the base-unit receptacle *146* (Fig. 7) such that the cartridge assembly *132* or another module (not shown) can simultaneously occupy the receptacle *146* with the module *180*.

Fig. 11 is a modular AED system *188*, which includes an AED base unit *190* and communication module *192* according to an embodiment of the invention, where like numbers identify like components with respect to the AED system *130* (Fig. 7).

The base unit *190* is similar to the base unit *136* except that it includes a receptacle *194* for receiving the communication module *192*. The receptacle *194* includes a connector *196* for mating with a corresponding connector (not shown) on the bottom of the module *192*.

The communication module *192* allows an operator (hands shown in Fig. 11) to communicate with someone, such as a doctor (not shown), at a remote location, such as a hospital (not shown), before, during, or after a rescue operation. The module *192* includes a microphone *198* for picking up the operator's voice, an antenna *200*, which allows wireless communication between the operator and the remote location, and an optional speaker *201*. The speaker *24*, the speaker *201*, or both the speakers *24* and *201* may allow the operator to hear the voice of a person at the remote location. The module *192* may receive power from the base unit *190*, or may include a power supply such as a battery (not shown). Furthermore, where the wireless communication is over a wireless telephone network, the base unit *190* or module *192* includes circuitry (not shown) for dialing a predetermined telephone number. The base unit *190* or module *192* may cause the this circuitry to dial the telephone number automatically when the operator powers on the base unit, or may wait for a specific instruction from the operator.

Alternate embodiments of the base unit *190* and module *192* are contemplated. For example, the module *192* may include a telephone keypad and telephone line connector like the module *112* (Fig. 6). In such an embodiment, the module *192* can be used for voice communications and for downloading rescue data as discussed above in conjunction with Fig. 6. Furthermore, the module *192* may include a speaker separate from the speaker *24* to

allow the operator to hear the voice of a person at the remote location. In addition, the module *192* may lack the microphone *198*, and the microphone *34* may pick up the operator's voice for transmission to the remote location. Moreover, the microphone *198*, the antenna *200*, the communication circuitry (not shown) within the module *192*, and other components (not shown) of the module *192* may be integral with the base unit *190*. Furthermore, the AED base unit *44* of Fig. 2 can be modified to receive the module 192. In addition, other embodiments may incorporate modifications similar to those discussed above in conjunction with Fig. 3 for the other embodiments of the control module *70*.

Fig. 12 is a schematic block diagram of a base-unit circuit *210*, which the base units *44* (Fig. 2), *136* (Fig. 7), and *190* (Fig. 11) may incorporate according to an embodiment of the invention. The circuit *210* includes a functional circuit *212* and one or more — here n — module interfaces *214*. The functional circuit *212* may include and execute software, and performs functions such as turning on and off the modular AEDs *40*, *130*, and *188*, analyzing a patient's heart rhythm and determining whether it is a shockable rhythm, generating a defibrillation shock if the rhythm is shockable, and sending rescue data to a remote location directly or via a module such as the control module *110* (Fig. 6). The circuit *212* may also control the speaker *24* and the microphone *34*, interface with the data card *36*, and manage the power supply for the base unit and any connected control modules. Each module interface *214* interfaces the functional circuit *212* to a respective module such as the control module *134* (Fig. 7). Each interface *214* typically includes at least one connector such as the connector *150* (Fig. 7), and may include an interface circuit (not shown). For example, the base unit *136* (Fig. 7) may include a single module interface *214* having the two connectors *148* and *150*, or may include two interfaces *214* each having a respective one of the connectors *148* and *150*.

Fig. 13 is a schematic block diagram of a module circuit *220*, which the modules *42* (cartridge assembly of Fig. 2), *70* (Fig. 3), *90* (Fig. 4), *100* (training cartridge assembly of Fig. 5), *110* (Fig. 6), *132* (cartridge assembly) and *134* (Fig. 7), *160* (Fig. 8), *170* (Fig. 9), *180* (Fig. 10), and *192* (Fig. 11) may incorporate according to an embodiment of the invention. The circuit *220* includes a functional circuit *222* and one or more — here n — base-unit interfaces *224*. The functional circuit *222* may include and execute software, and performs functions such as turning on and off the modular AED systems *130* and *188* (Figs. *7* and *11*), controlling the display of information from the base unit (*e.g.,* base unit *136* of Fig. 7) on a display screen (*e.g.,* display screen *72* of Fig. 3), allowing an operator to select menu items or AED functions from the display screen (*e.g.* via buttons *84* of Fig. 3), providing a

status of the AED (*e.g.*, via indicator *74* or LEDs *80* of Fig. 3), instructing the base unit to deliver a shock in response to an operator (not shown in Fig. 13) pushing the shock button *142* (Figs. 7– 10), and dialing a telephone number (*e.g.*, via the key pad *112* of Fig. 6). Each base-unit interface *224* interfaces the module functional circuit *222* to the base-unit functional circuit *212* (Fig. 12) of a base unit, such as the base unit *136* (Fig. 7), via one or more respective module interfaces *214* (Fig. 12). Each base-unit interface *224* typically includes at least one connector such as the connector *82* (Fig. 3), and may include an interface circuit (not shown). For example, the full-featured control module *170* (Fig. 9) may include a single base-unit interface *224* having two connectors (not shown) that respectively mate with the base-unit connectors *148* and *150* (Fig. 7), or may include two interfaces *224* each having a connector that mates with a respective one of the connectors *148* and *150.* Alternatively, for modules such as the cartridge assemblies *42, 100,* and *132,* of Figs. 2, 5, and 7 respectively, the functional circuit *212* may be an energy-attenuation circuit, power circuit, or other type of circuit. Or, these modules may altogether omit the functional circuit *212.*

Fig. 14 is a schematic block diagram of an AED circuit *230*, which the modular AED systems *40* (Fig. 2), *130* (Fig. 7), and *188* (Fig. 11) can incorporate according to an embodiment of the invention. Table I below gives examples of which of the circuit blocks are disposed in the base unit *44, 136,* or *190* and which of the circuit blocks are disposed in the module or modules connected to the base unit. Furthermore, the defibrillator electrode pads *16a* and *16b* are typically coupled to the base unit via a module. But there is no requirement that a particular circuit block be disposed in the base unit or in a module, or that the pads be connected to or be part of a module. Therefore, circuit blocks disposed in the base unit may be disposed in the module or modules, and vice versa, and the pads may be connected directly to the base unit. For clarity, unless otherwise noted, the AED circuit *230* is described as being part of the modular AED system *130* with the cartridge assembly *132* and the enhanced control module *160* (Fig. 8) attached, it being understood that the circuit *230* is similar when part of the modular AED systems *40* and *188.*

Referring to Fig. 14, the defibrillator electrode pads *16a* and *16b* are coupled to the circuit *230* via the connectors *138* and *148* and are operable to sense a patient's ECG (not shown) and to apply an electrical shock to the patient (not shown). A shock-delivery-and-ECG front-end circuit *232* samples the patient's ECG during an analysis mode of operation, and provides a shock to the patient via the connectors *138* and *148* and the electrode pads *16a* and *16b* during a shock-delivery mode of operation. A gate array *234*

receives the ECG samples from the circuit *232* and provides them to a first processor unit (PU) *236*, which stores and analyzes the samples. If analysis of the patient's ECG indicates that the patient is suffering from a shockable heart rhythm, then the processor unit *236* instructs the circuit *232*, via the gate array *234*, to enable delivery of a shock when an operator (not shown in Fig. 14) presses the shock button *142* (which is coupled to the processor unit *236* via the connector *150* of Fig. 7). Conversely, if analysis of the patient's ECG indicates that the patient is not suffering from a shockable heart rhythm, then the processor unit *236* may disable the circuit *232* from delivering a shock to the patient, and may instruct the operator via the speaker *24* or display *162* to seek non-shock treatment for the patient. Furthermore, the processor unit *236* can detect and signal the operator (*e.g.*, via the speaker *24*, the LEDs *252*, or status circuit *242*) when a module is not coupled to the module connector *148* or *150* (Fig. 7).

The circuit *230* also includes a power-management circuit *238* for distributing power from the battery *18* to the subcircuits of the circuit *230*. The on/off switch *140* turns the circuit *230* "on" and "off", a status circuit *242* indicates the status of the circuit *230*, and a second processor unit *244* interfaces the power-management circuit *238*, the on/off circuit *140* (via the connector *150* of Fig. 7), and the status circuit *242* to the circuit *232*, the first processor unit *236*, and the gate array *234*. As discussed above in conjunction with Figs. 2 - 3, the display *162* (comparable to the display *72* of Fig. 3 in one embodiment) displays information to the operator, the speaker *24* provides audio instructions to the operator, and the microphone *34* records the operator's voice and other audible sounds. The data card *36* is connected to the gate array *234* via a port *248*. The card *36* stores the operator's voice and other sounds along with the patient's ECG and a record of AED events for later study. Alternatively, another storage device such as magnetic tape (not shown) may store this data. A status-measurement circuit *250* provides the status of the circuit *230* subcircuits to the processor unit *236*, and LEDs *252* provide information to the operator such as whether the processor unit *236* has enabled the circuit *232* to deliver a shock to the patient. A contrast control *254*, which the operator may manipulate via the control knob *164* (Fig. 8), allows the operator to control the contrast of the display screen *162*, and a memory such as a read only memory (ROM) *256* stores programming information for the processor units *236* and *244* and the gate array *234*.

Still referring to Fig. 14, the circuit *230* also includes the optional microphone *198*, a data transmitter/receiver *258*, and a training-scenario selector circuit *260*.

As discussed above in conjunction with Figs. 6 and 11, the transmitter/receiver *258* allows communication of data between the AED circuit *230* and a remote location (not shown) such as a hospital via a landline (Fig. 6) or wireless telephone channel. For example, the transmitter/receiver *258* may receive data from the data card *36* via the gate array *234* and transmit the data to the remote location. Or, the transmitter/receiver *258* may receive voice data from the microphone *34* or *198* and transmit this data to the remote location. Alternatively, the transmitter/receiver *258* may provide data received from the remote location to the processor *236* via the gate array *234*. The processor unit *236* may convert the received data into a voice using the speaker *24*.

The training-scenario selection circuit *260* allows training of a student in the operation of the AED system *130* (Fig. 7), when the training cartridge assembly *100* is attached to the base unit *136* (Fig. 7) in a manner similar to that discussed above in conjunction with Fig. 5. When the circuit *260* is coupled to the connector *148*, the pads *16a* and *16b* typically are not electrically coupled to the connector *148* to prevent inadvertent delivery of a shock during the training exercise. But the circuit *260* "fools" the processor unit *236* into determining that a selected scenario exists such that the processor unit causes the circuit *230* to operate according to this scenario. For example, the circuit *230* may cause the processor unit *236* to determine that a "patient" is experiencing a shockable heart rhythm, and thus to cause the circuit *230* to operate accordingly. This allows the student to learn the operation of the AED without putting a test patient at risk.

Once can modify the circuit *230* according to known principles such that the AED system *130* can provide electrotherapies other than defibrillation, such as pacing and cardioversion, or includes a manual override that allows an operator (not shown in Fig. 14) more control over otherwise automated functions.

An AED circuit similar to the AED circuit *230* and other AED circuits are further discussed in the following references, which are incorporated by reference: U.S. Patent No. 5,836,993, U.S. Patent No. 5,735,879 entitled ELECTROTHERAPY METHOD AND APPARATUS, U.S. Patent No. 5,607,454 entitled ELECTROTHERAPY METHOD AND APPARATUS, and U.S. Patent No. 5,879,374 entitled DEFIBRILLATOR WITH SELF-TEST FEATURES.

Table I describes the locations of the circuit blocks of the AED circuit *230* (Fig. 14) and other circuits and components of the base unit and module(s) according to respective embodiments of the invention. Unless otherwise stated, reference numerals in Table I refer to circuit blocks or components in Fig. 14.

Table I

(One of Modules 1, 2, and 3 Connected to the Base Unit at a Time)

Base Unit	Module 1	Module 2	Module 3
Battery 18	Adult Electrode Pads 16a and 16b	Pediatric Electrode Pads 16a and 16b	Training Electrode Pads 16a and 16b
Speaker 24	Pad Storage Compartment (not shown, but similar to the compartment 62 of Fig. 2)	Pad Storage Compartment (not shown, but similar to the compartment 62 of Fig. 2)	Pad Storage Compartment (not shown, but similar to the compartment 62 of Fig. 2)
On/Off Button 140	Electrode Pad Connector (*e.g.*, 176 of Fig. 9)	Electrode Pad Connector (*e.g.*, 176 of Fig. 9)	Electrode Pad Connector (*e.g.*, 176 of Fig. 9)
Shock Delivery and ECG 232	Module Identifier Circuit (not shown, identifies type of module to base unit)	Module Identifier Circuit (not shown, identifies type of module to base unit)	Module Identifier Circuit (not shown, identifies type of module to base unit)
Gate Array 234	Module Unconnected (to base unit) Circuit (not shown)	Module Unconnected (to base unit) Circuit (not shown)	Module Unconnected (to base unit) Circuit (not shown)
Pus 236 and 244	Module Connector (*e.g.*, connector 82 of Fig. 4) and Base-Unit Interface Circuitry (*e.g.*, base-unit interface 224 of Fig. 13)	Module Connector (*e.g.*, connector 82 of Fig. 4) and Base-Unit Interface Circuitry (*e.g.*, base-unit interface 224 of Fig. 13)	Module Connector (*e.g.*, connector 82 of Fig. 4) and Base-Unit Interface Circuitry (*e.g.*, base-unit interface 224 of Fig. 13)
Power Management 238		Energy Attenuation Circuit (not shown)	Module Battery (not shown)

Base Unit	Module 1	Module 2	Module 3
Status Measurement 250 LEDs 252 ROM 256 Data Transmitter-Receiver 258 Module Connectors 148 and 150 (and module interface circuitry such as module interface 214 of Fig. 12)			Training-Scenario Selector 102 (Fig. 5) Including Training-Scenario Selector Circuit 260 (Fig. 14)

CLAIMS:

1. A defibrillator base unit (44), comprising:
a functional circuit (212); and
a first interface (214) operable to couple the functional circuit to a first defibrillator module (70).

2. The base unit of claim 1 wherein the functional circuit is operable to provide electrotherapy to a patient.

3. The base unit of claims 1 and 2, further comprising:
a shock-delivery control (70); and
wherein the functional circuit (212) is operable to generate a defibrillation shock in response to the shock-delivery control.

4. The base unit of claims 1, 2, and 3 wherein the functional circuit (212) is operable to determine whether a patient is experiencing a shockable heart rhythm.

5. A defibrillator module (70), comprising:
a functional circuit (212); and
a first interface (214) operable to couple the functional circuit to a defibrillator base unit.

6. The module of claim 5, further comprising a second interface (214) operable to couple the functional circuit to the base unit.

7. The module of claims 5 and 6, further comprising:
a shock-delivery control (70); and
wherein the base unit is operable to generate a defibrillation shock in response to the shock-delivery control.

8. The module of claims 5, 6, and 7, further comprising a monitor (90) operable to display patient information.

9. A defibrillator module (70), comprising:
a defibrillator electrode pad (16);
a compartment (48) operable to store the defibrillator electrode pad (16); and
an interface (30, 32) operable to couple the defibrillator electrode pad to a defibrillator base unit.

10. A modular automated external defibrillator system (12), comprising:
a base unit (44) having,
a base-unit circuit (44), and
a first base-unit interface coupled to the base-unit circuit; and
a first module having,
a first module circuit (40), and
a first module interface (214) operable to couple the module circuit to the base-unit circuit via the first base-unit interface.

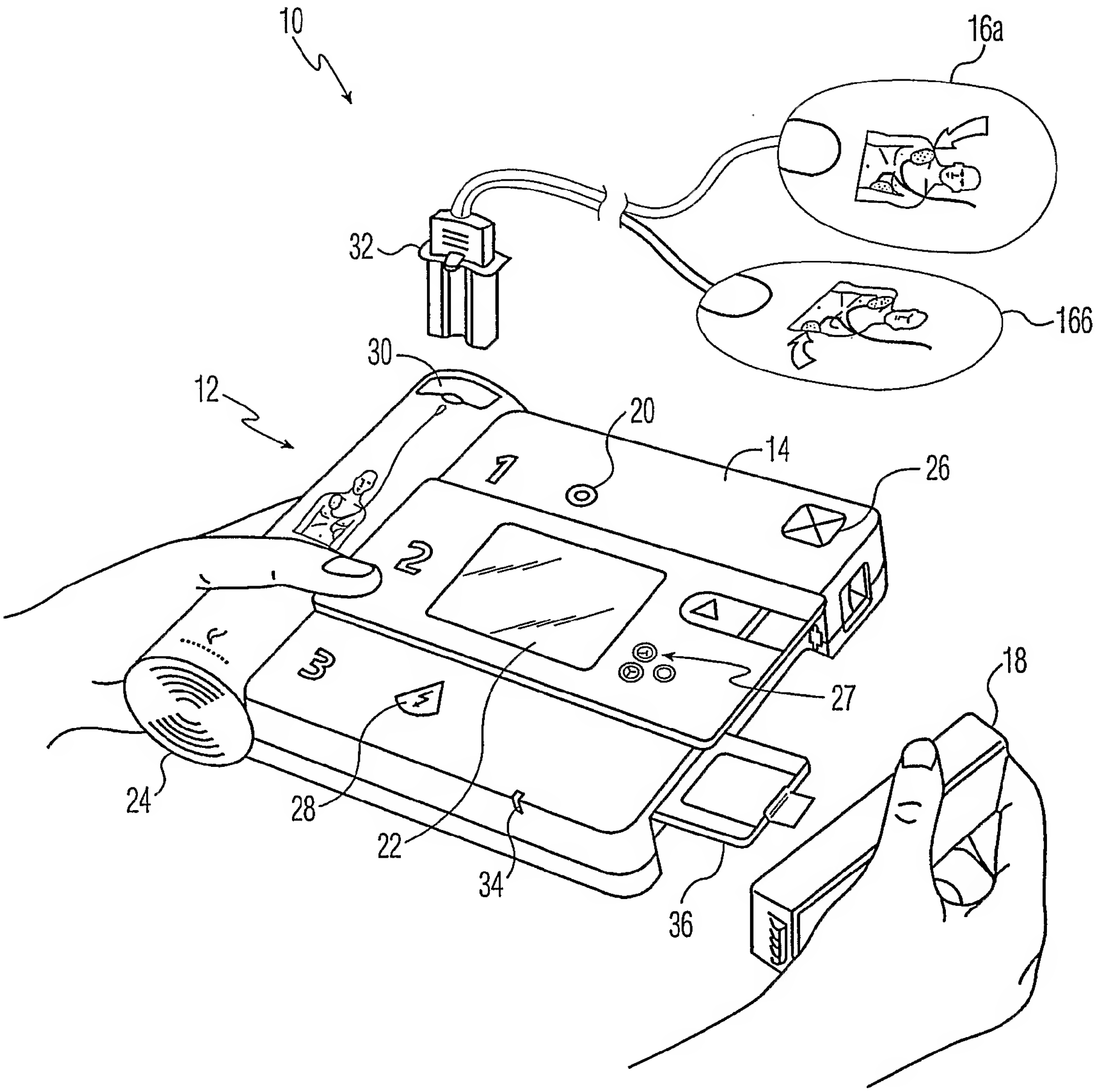
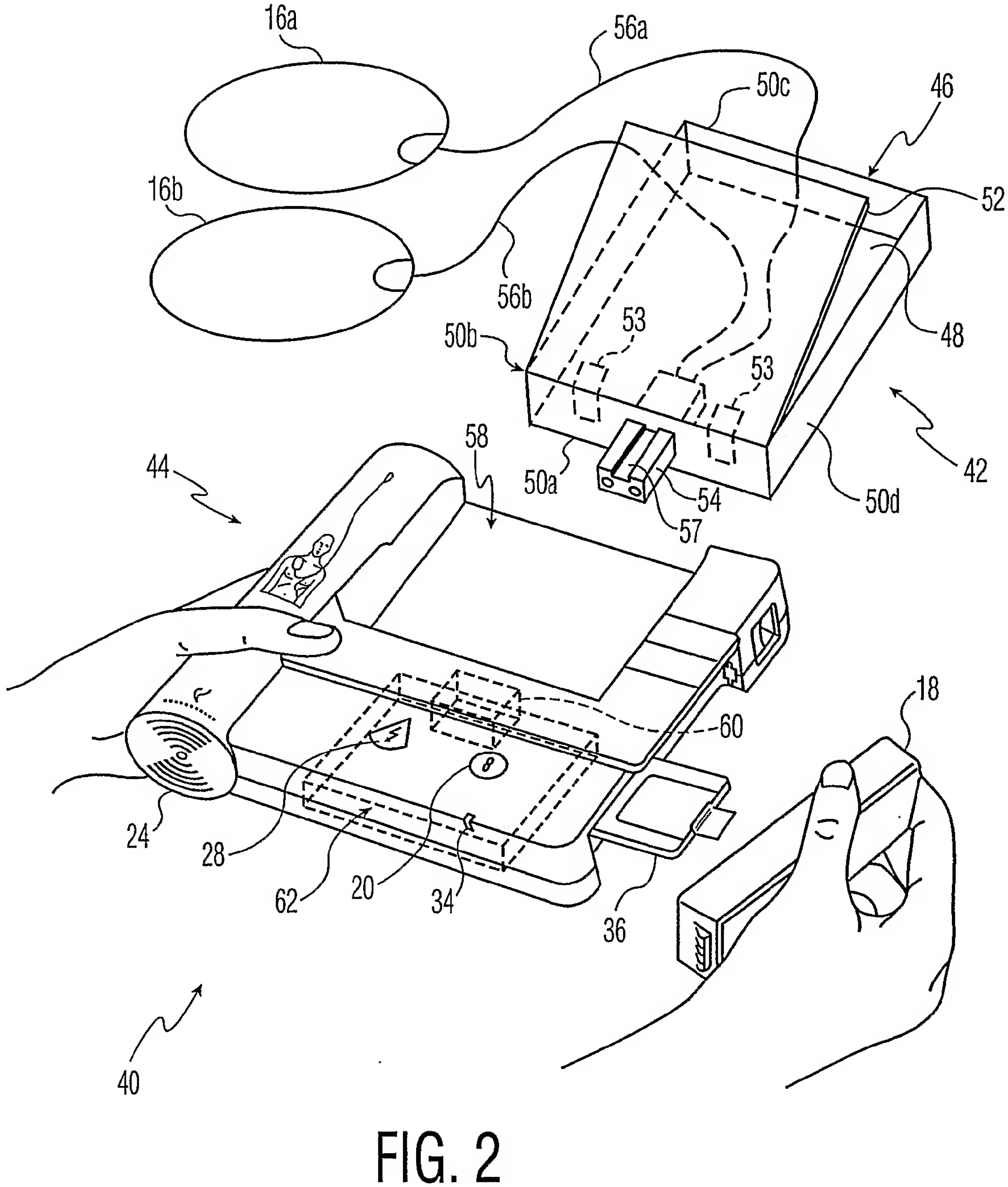


FIG. 1
PRIOR ART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56a
50c
46
52
16b
56b
48
53
50b
53
58
44
50a
54
42
57
50d
60
18
24
28
62
20
34
36
40

FIG. 2

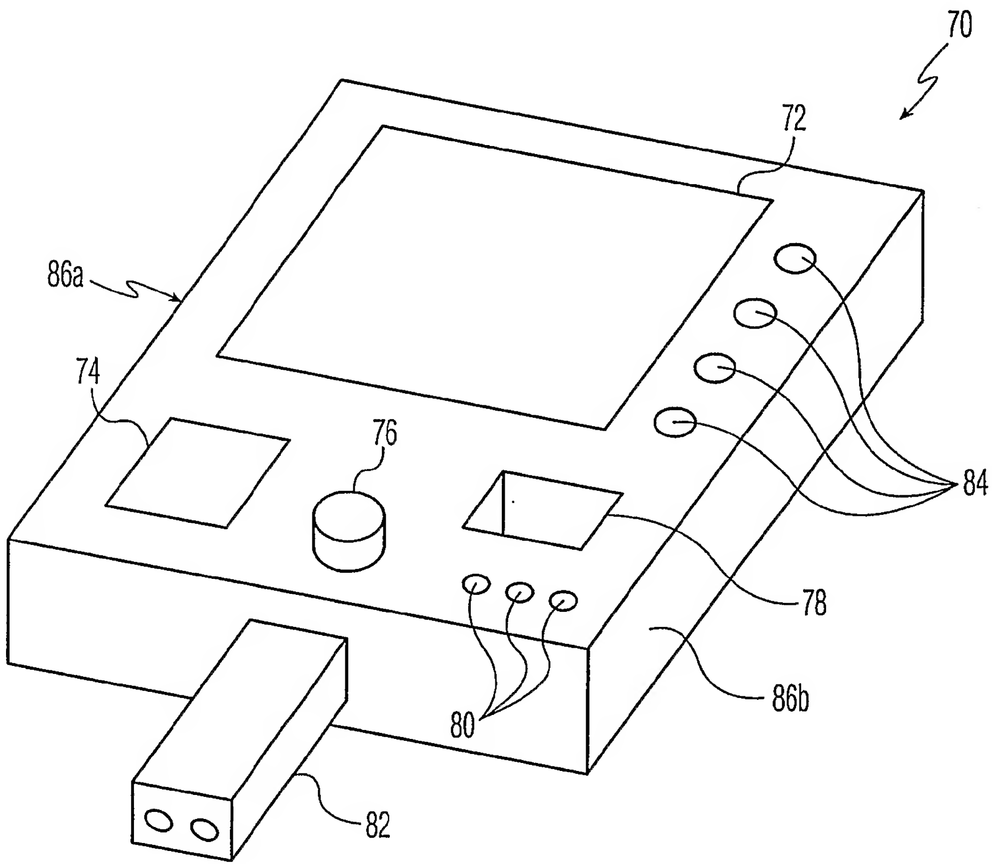


FIG. 3

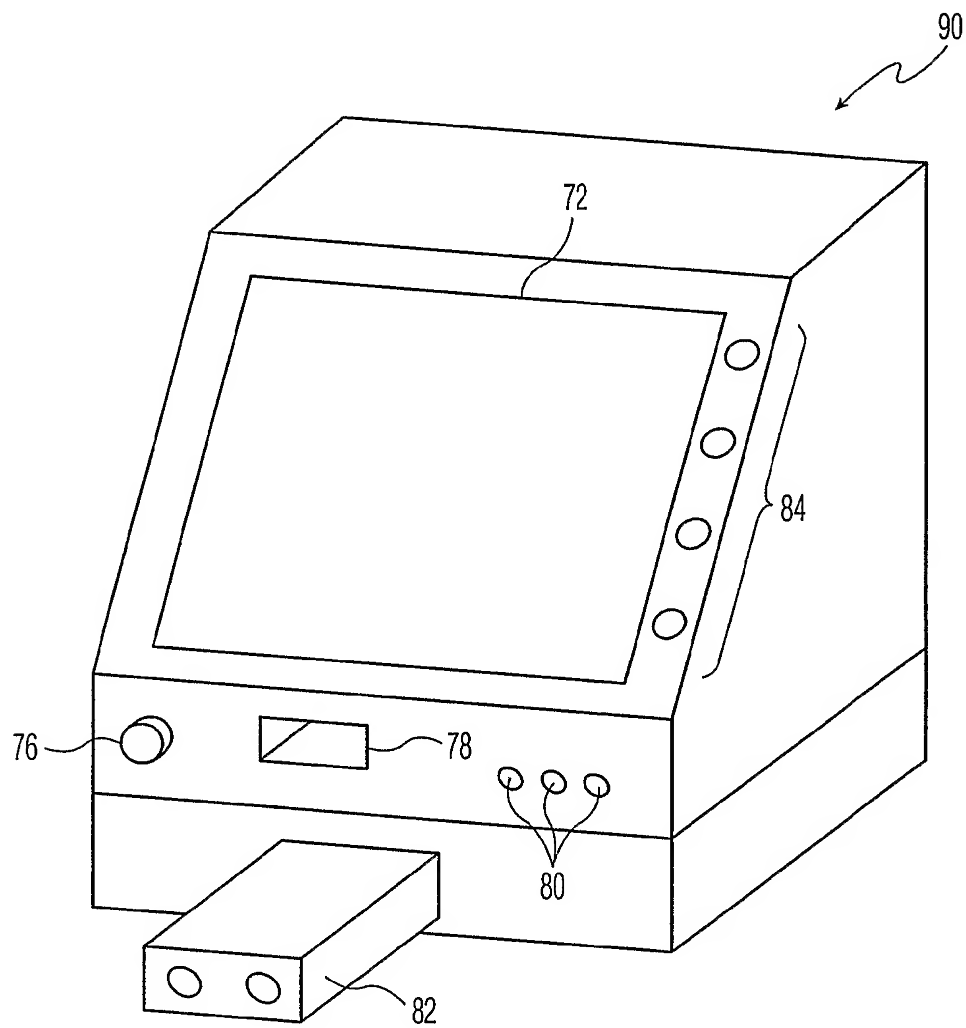


FIG. 4

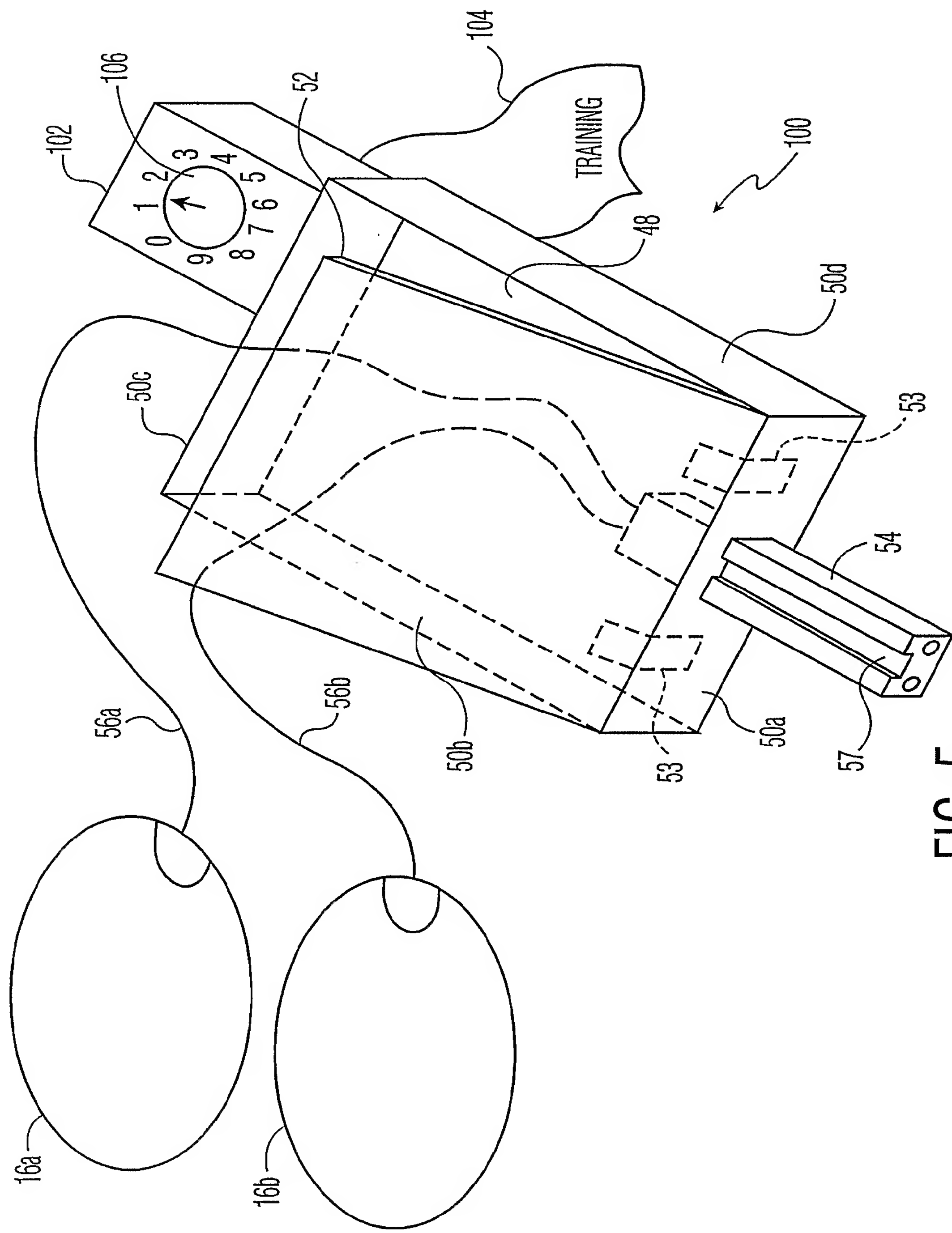
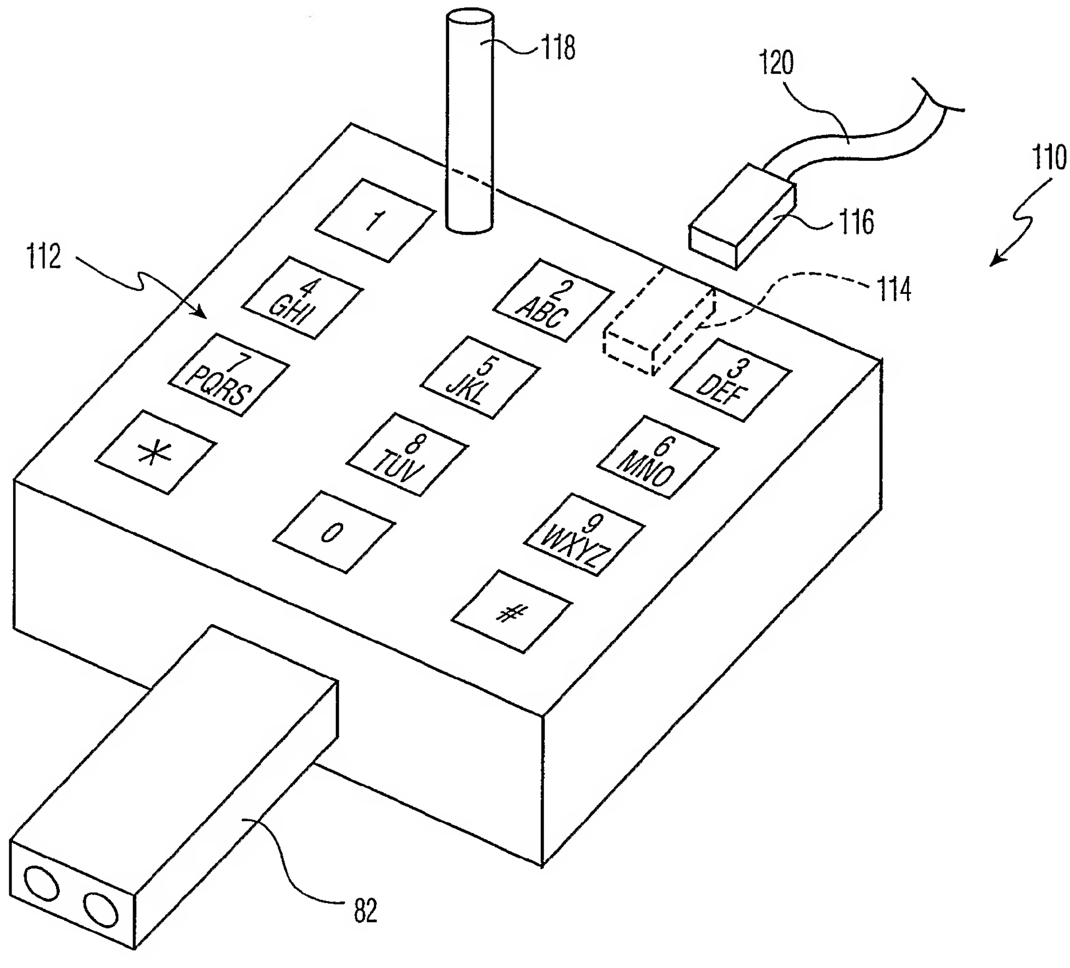

104
106
102
0 1 2 3 4 5 6 7 8 9
52
TRAINING
100
48
50d
50c
53
54
50b
53
50a
57
56a
56b
16a
16b

FIG. 5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110
116
112
114
1
4
GHI
2
ABC
7
PQRS
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JKL
3
DEF
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TUV
6
MNO
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9
WXYZ
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82

FIG. 6

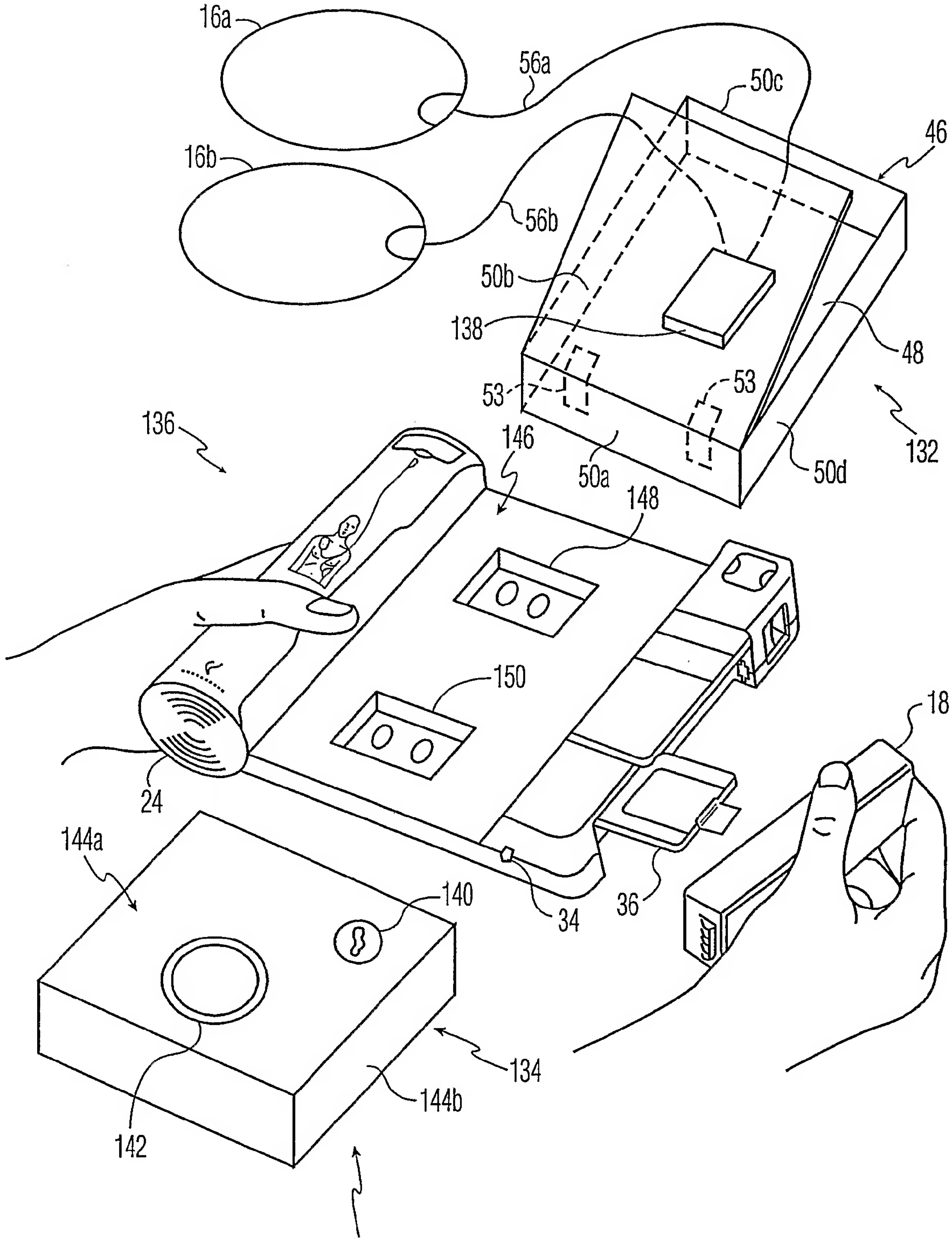

16a
56a
50c
46
16b
56b
50b
138
48
53
53
132
136
146
50a
50d
148
150
18
24
144a
140
34
36
142
134
144b
130

FIG. 7

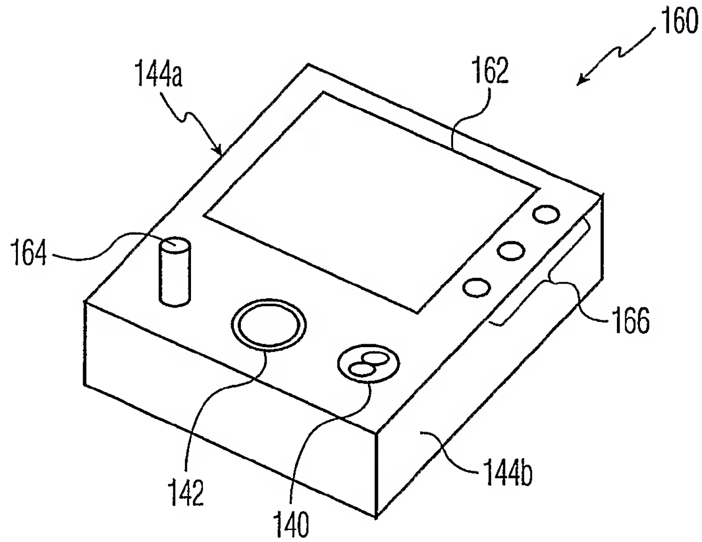
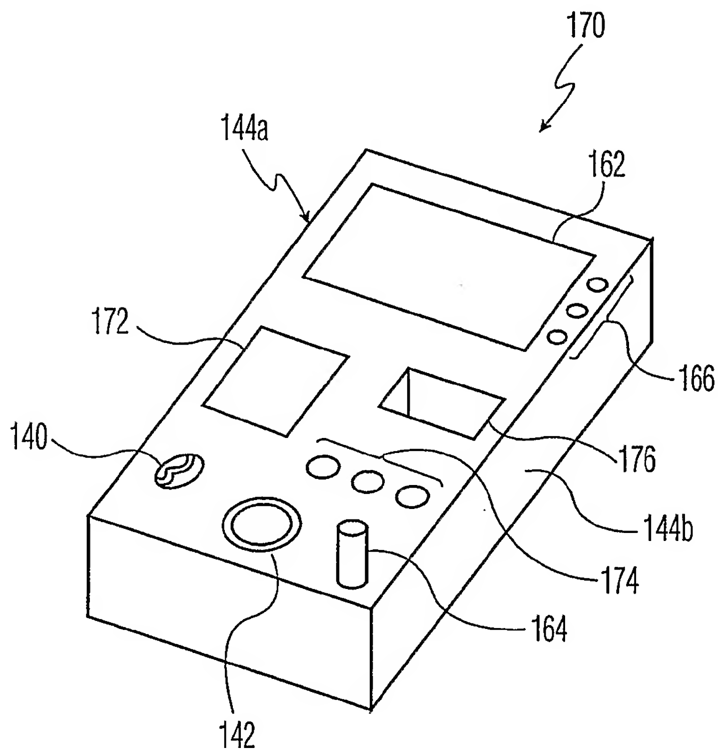

160
144a
162
164
166
142
140
144b

FIG. 8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144a
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144b
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164
142

FIG. 9

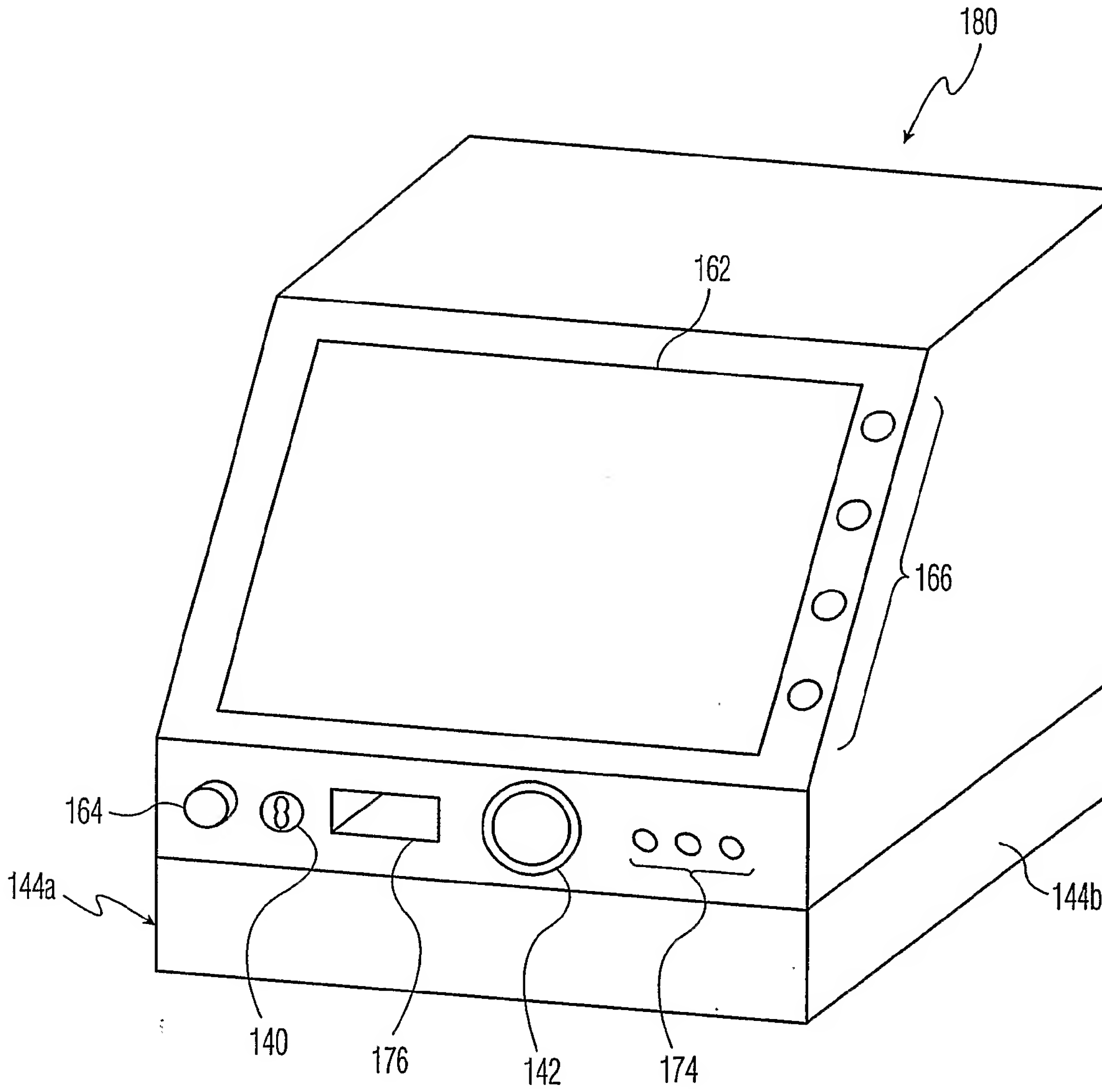

FIG. 10

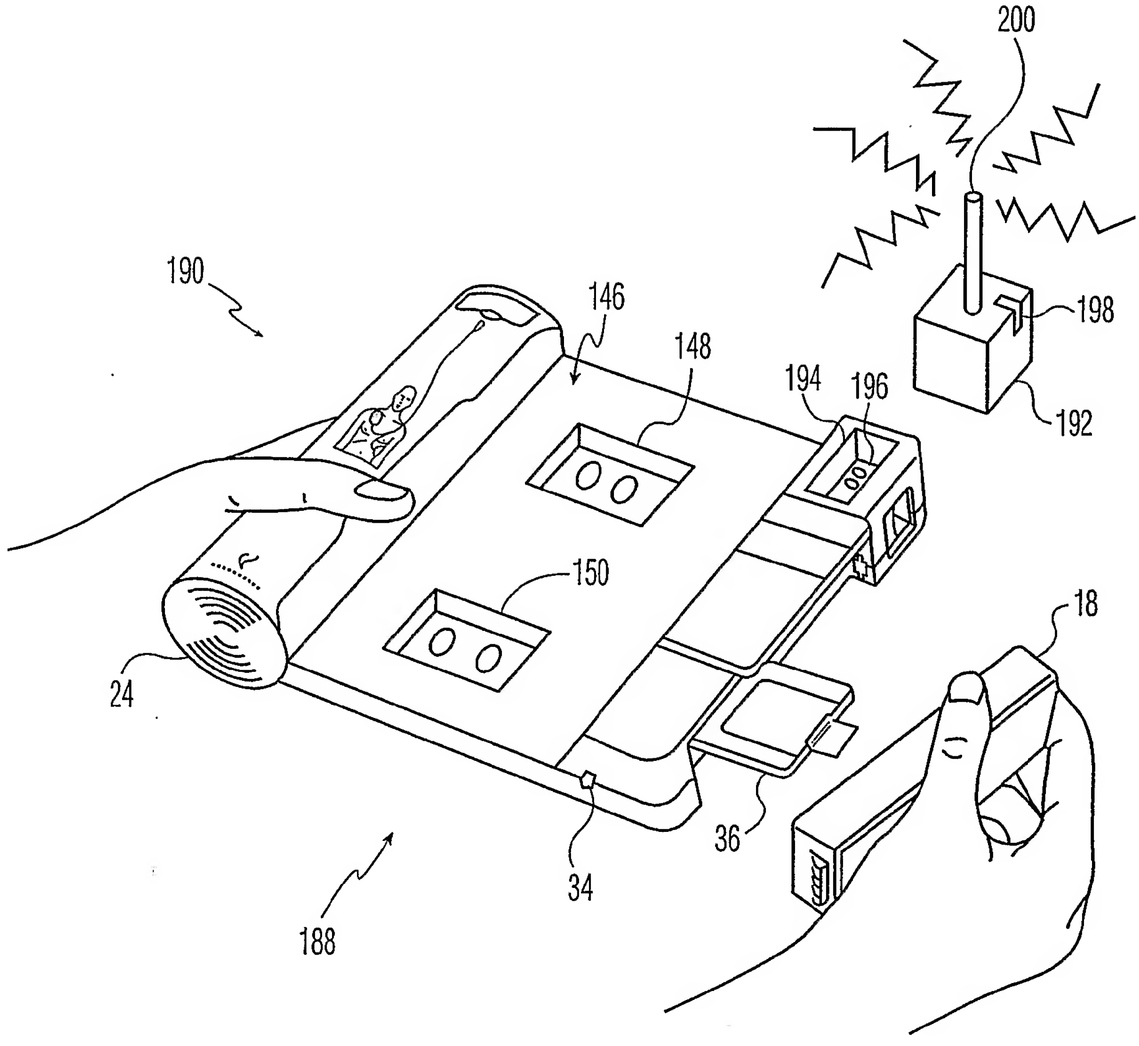

FIG. 11

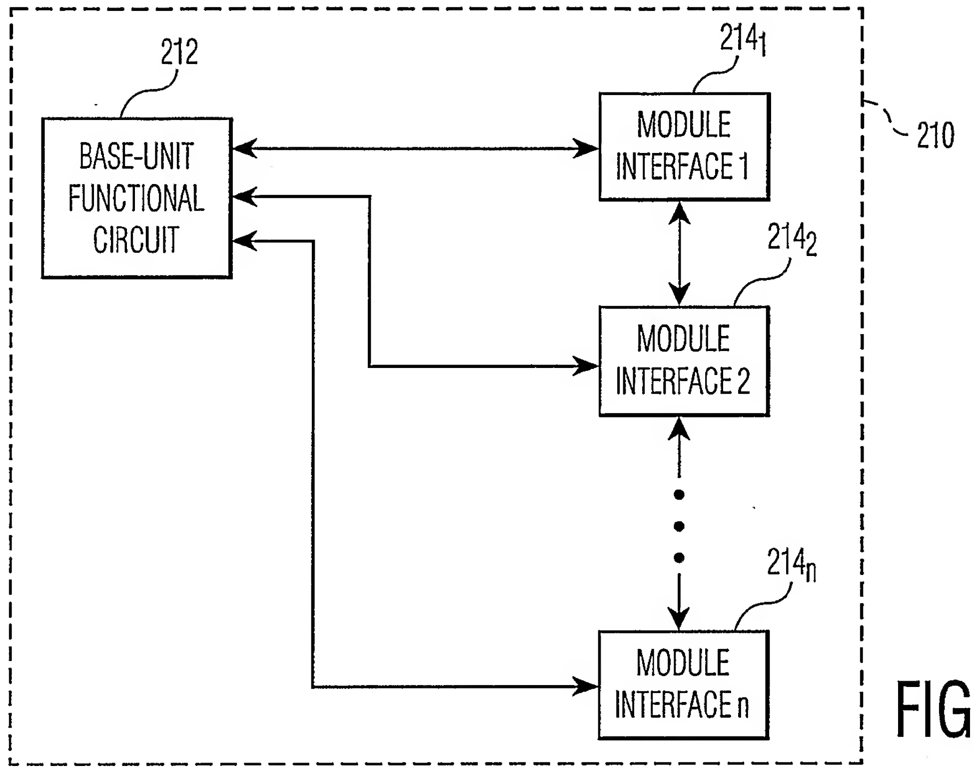
212
BASE-UNIT FUNCTIONAL CIRCUIT
214_1
MODULE INTERFACE 1
214_2
MODULE INTERFACE 2
214_n
MODULE INTERFACE n
210

FIG. 12

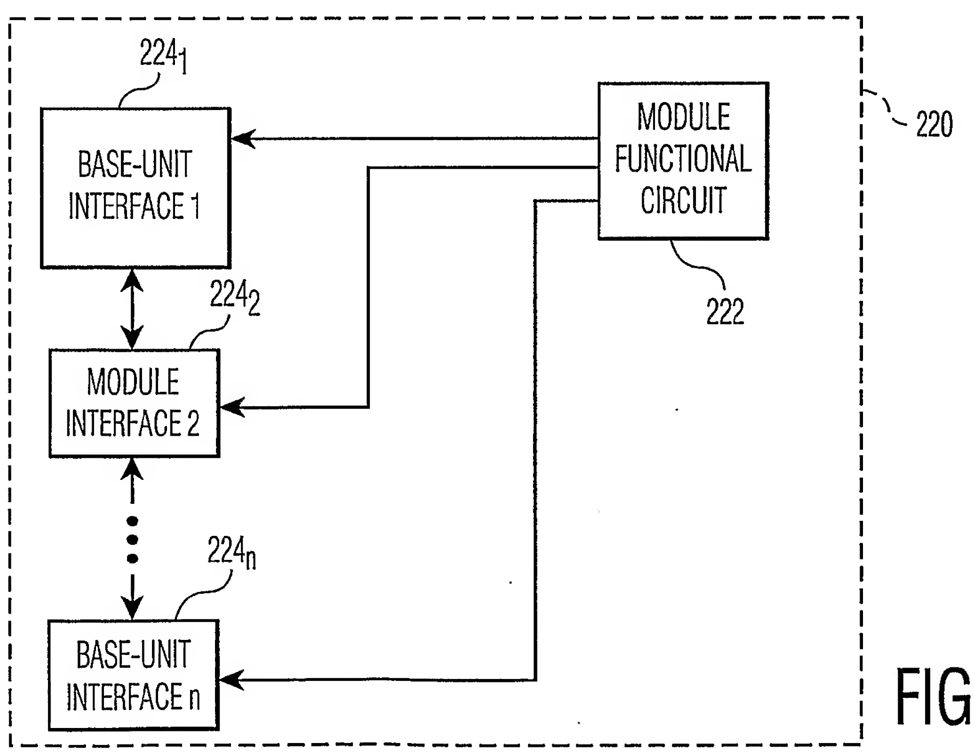
224_1
BASE-UNIT INTERFACE 1
224_2
MODULE INTERFACE 2
224_n
BASE-UNIT INTERFACE n
MODULE FUNCTIONAL CIRCUIT
222
220

FIG. 13

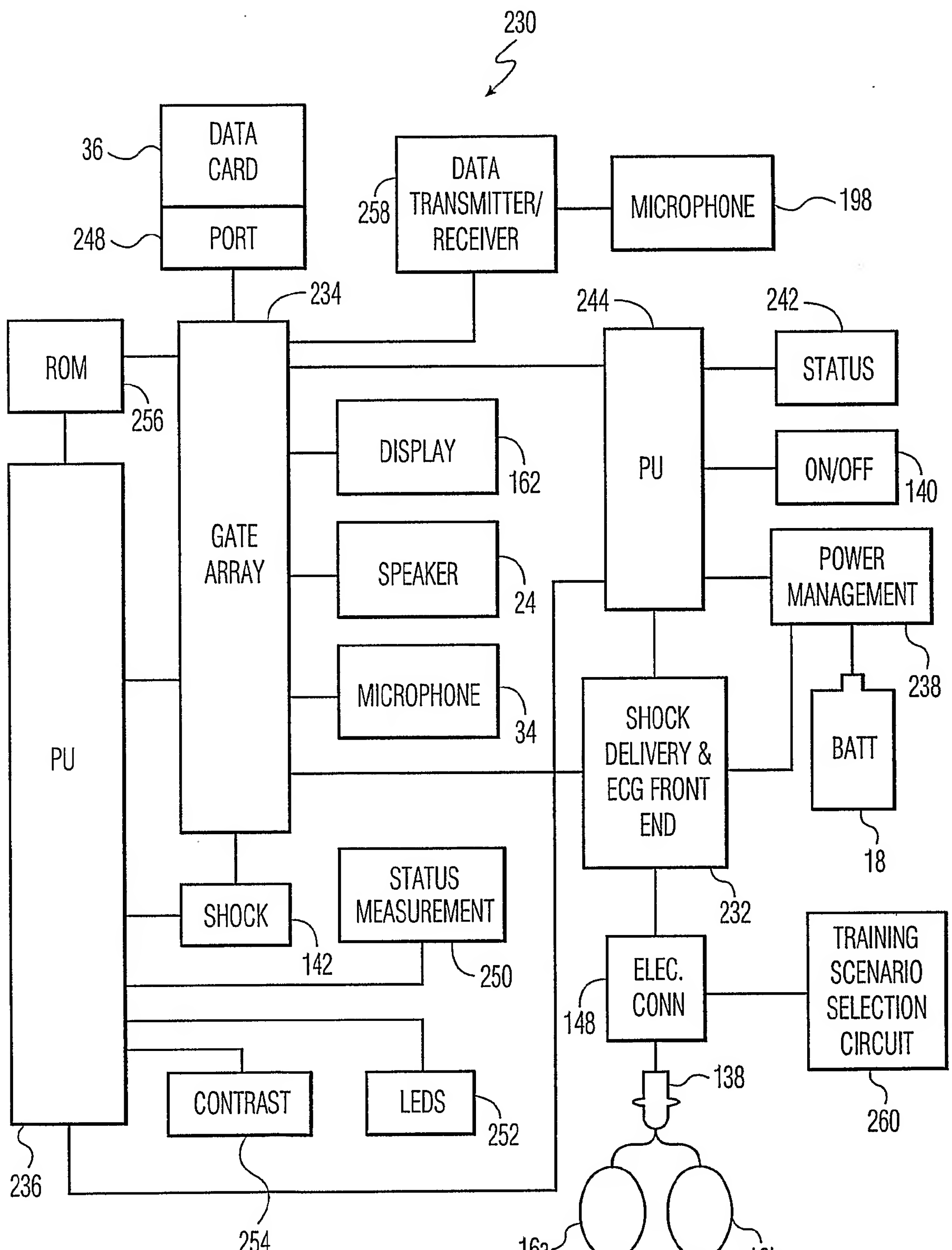
230
DATA CARD
36
PORT
248
DATA TRANSMITTER/ RECEIVER
258
MICROPHONE
198
234
244
242
ROM
256
GATE ARRAY
DISPLAY
162
SPEAKER
24
MICROPHONE
34
PU
STATUS
ON/OFF
140
POWER MANAGEMENT
238
BATT
18
PU
SHOCK DELIVERY & ECG FRONT END
232
SHOCK
142
STATUS MEASUREMENT
250
ELEC. CONN
148
TRAINING SCENARIO SELECTION CIRCUIT
260
138
CONTRAST
LEDS
252
236
254
16a
16b

FIG. 14

INTERNATIONAL SEARCH REPORT

Inf onal Application No
PCT/IB 02/03090

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61N1/39

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	EP 1 002 555 A (HEWLETT PACKARD CO) 24 May 2000 (2000-05-24) abstract figures 1,2A	1-10
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X	US 5 713 927 A (HAMPELE ROLAND ET AL) 3 February 1998 (1998-02-03) abstract column 2, line 41 - line 60	1-3,5-8, 10

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 December 2002	20/12/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lohmann, S

In' onal Application No
PCT/IB 02/03090

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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In   ional Application No
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